

Electrical and Electronics Installers and Repairers

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Significant Points

- Knowledge of electrical equipment and electronics is necessary for employment; many applicants complete 1 to 2 years at vocational schools and community colleges, although some less skilled repairers may have only a high school diploma.
- Employment is projected to grow more slowly than average, but will vary by occupational specialty.
- Job opportunities will be best for applicants with a thorough knowledge of electrical and electronic equipment, as well as repair experience.

Nature of the Work

Businesses and other organizations depend on complex electronic equipment for a variety of functions. Industrial controls automatically monitor and direct production processes on the factory floor. Transmitters and antennae provide communication links for many organizations. Electric power companies use electronic equipment to operate and control generating plants, substations, and monitoring equipment. The Federal Government uses radar and missile control systems to provide for the national defense and to direct commercial air traffic. These complex pieces of electronic equipment are installed, maintained, and repaired by electrical and electronics installers and repairers.

Electrical equipment and electronic equipment are two distinct types of industrial equipment, although much equipment contains both electrical and electronic components. In general, electrical portions provide the power for the equipment, while electronic components control the device, although many types of equipment still are controlled with electrical devices. Electronic sensors monitor the equipment and the manufacturing process, providing feedback to the programmable logic control (PLC), which controls the equipment. The PLC processes the information provided by the sensors and makes adjustments to optimize output. To adjust the output, the PLC sends signals to the electrical, hydraulic, and pneumatic devices that power the machine—changing feed rates, pressures, and other variables in the manufacturing process. Many installers and repairers, known as *field technicians*, travel to factories or other locations to repair equipment. These workers often have assigned areas in which they perform preventive maintenance on a regular basis. When equipment breaks down, field technicians go to a customer's site to repair the equipment. *Bench technicians* work in repair shops located in factories and service centers, fixing components that cannot be repaired on the factory floor.

Some industrial electronic equipment is self-monitoring and alerts repairers to malfunctions. When equipment breaks down, repairers first check for common causes of trouble, such as loose connections or obviously defective components. If routine checks do not locate the trouble, repairers may refer to schematics and manufacturers' specifications that show connections and provide instructions on how to locate problems. Automated electronic control systems are increasing in complexity, making diagnosis more challenging. Repairers use software programs and testing equipment to diagnose malfunctions. Among their diagnostic tools are multimeters, which measure voltage, current, and resistance; and advanced multimeters,

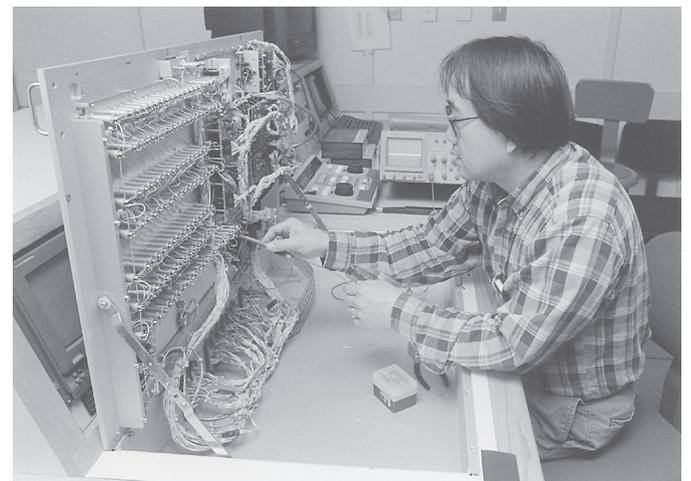
which measure capacitance, inductance, and current gain of transistors. Repairers also use signal generators, which provide test signals, and oscilloscopes, which display signals graphically. Finally, repairers use handtools such as pliers, screwdrivers, soldering irons, and wrenches to replace faulty parts and adjust equipment.

Because repairing components is a complex activity and factories cannot allow production equipment to stand idle, repairers on the factory floor usually remove and replace defective units, such as circuit boards, instead of fixing them. Defective units are discarded or returned to the manufacturer or a specialized shop for repair. Bench technicians at these locations have the training, tools, and parts needed to thoroughly diagnose and repair circuit boards or other complex components. These workers also locate and repair circuit defects, such as poorly soldered joints, blown fuses, or malfunctioning transistors.

Electrical and electronics installers often fit older manufacturing equipment with new automated control devices. Older manufacturing machines are frequently in good working order, but are limited by inefficient control systems for which replacement parts are no longer available. Installers replace old electronic control units with new PLCs. Setting up and installing a new PLC involves connecting it to different sensors and electrically powered devices (electric motors, switches, and pumps) and writing a computer program to operate the PLC. Electronics installers coordinate their efforts with those of other workers who are installing and maintaining equipment. (See the statement on industrial machinery installation, repair, and maintenance workers elsewhere in the *Handbook*.)

Electrical and electronics installers and repairers, transportation equipment install, adjust, or maintain mobile electronic communication equipment, including sound, sonar, security, navigation, and surveillance systems on trains, watercraft, or other mobile equipment. *Electrical and electronics repairers, powerhouse, substation, and relay* inspect, test, repair, or maintain electrical equipment in generating stations, substations, and in-service relays. These workers may be known as powerhouse electricians, relay technicians, or power transformer repairers. *Electric motor, power tool, and related repairers*—such as armature winders, generator mechanics, and electric golf cart repairers—specialize in repairing, maintaining, or installing electric motors, wiring, or switches.

Electronic equipment installers and repairers, motor vehicles have a significantly different job. They install, diagnose, and repair communication, sound, security, and navigation equipment in motor vehicles. Most installation work involves either new alarm or sound systems. New sound systems vary significantly in cost and com-



Electrical and electronic repairers use software and testing equipment to diagnose malfunctions.

plexity of installation. Replacing a head unit (radio) with a new computer disc (CD) player is quite simple, requiring the removal of a few screws and the connection of a few wires. Installing a new sound system with a subwoofer, amplifier, and fuses is far more complicated. The installer builds a fiberglass or wood box designed to hold the subwoofer and to fit inside the unique dimensions of the automobile. Installing sound-deadening material, which often is necessary with more powerful speakers, requires an installer to remove many parts of a car (for example, seats, carpeting, or interiors of doors), add sound-absorbing material in empty spaces, and reinstall the interior parts. The installer also runs new speaker and electrical cables. The new system may require additional fuses, a new electrical line to be run from the battery through a newly drilled hole in the firewall into the interior of the vehicle, or an additional or more powerful alternator or battery. Motor vehicle installers and repairers work with an increasingly complex range of electronic equipment, including DVD players, satellite navigation equipment, passive-security tracking systems, and active-security systems.

Working Conditions

Many electrical and electronics installers and repairers work on factory floors, where they are subject to noise, dirt, vibration, and heat. Bench technicians work primarily in repair shops, where the surroundings are relatively quiet, comfortable, and well lighted.

Installers and repairers may have to do heavy lifting and work in a variety of positions. They must follow safety guidelines and often wear protective goggles and hardhats. When working on ladders or on elevated equipment, repairers must wear harnesses to prevent falls. Before repairing a piece of machinery, these workers must follow procedures to ensure that others cannot start the equipment during the repair process. They also must take precautions against electric shock by locking off power to the unit under repair.

Motor vehicle electronic equipment installers and repairers normally work indoors in well-ventilated and well-lighted repair shops. Minor cuts and bruises are common, but serious accidents usually are avoided when safety practices are observed.

Employment

Electrical and electronics installers and repairers held about 172,000 jobs in 2002. The following tabulation breaks down their employment by occupational specialty:

Electrical and electronics repairers, commercial and industrial equipment	85,000
Electric motor, power tool, and related repairers	31,000
Electrical and electronics repairers, powerhouse, substation, and relay	21,000
Electronic equipment installers and repairers, motor vehicles	18,000
Electrical and electronics installers and repairers, transportation equipment	18,000

Many repairers worked for utilities, building equipment contractors, machinery and equipment repair shops, wholesalers, the Federal Government, retailers of automotive parts and accessories, rail transportation companies, and manufacturers of electrical, electronic, and transportation equipment.

Training, Other Qualifications, and Advancement

Knowledge of electrical equipment and electronics is necessary for employment. Many applicants gain this knowledge through programs lasting 1 to 2 years at vocational schools or community colleges, although some less skilled repairers may have only a high

school diploma. Entry-level repairers may work closely with more experienced technicians who provide technical guidance.

Installers and repairers should have good eyesight and color perception in order to work with the intricate components used in electronic equipment. Field technicians work closely with customers and should have good communication skills and a neat appearance. Employers also may require that field technicians have a driver's license.

Various organizations offer certification, including ACES International, the Consumer Electronics Association, the Electronics Technicians Association International, and the International Society of Certified Electronics Technicians. Repairers may specialize—in industrial electronics, for example. To receive certification, repairers must pass qualifying exams corresponding to their level of training and experience.

Experienced repairers with advanced training may become specialists or troubleshooters who help other repairers diagnose difficult problems. Workers with leadership ability may become supervisors of other repairers. Some experienced workers open their own repair shops.

Job Outlook

Job opportunities should be best for applicants with a thorough knowledge of electrical equipment and electronics, as well as with repair experience. Overall employment of electrical and electronics installers and repairers is expected to grow more slowly than the average for all occupations over the 2002-12 period, but varies by occupational specialty. In addition to employment growth, many job openings should result from the need to replace workers who transfer to other occupations or leave the labor force.

Average employment growth is projected for electrical and electronics installers and repairers of commercial and industrial equipment. This equipment will become more sophisticated and will be used more frequently as businesses strive to lower costs by increasing and improving automation. Companies will install electronic controls, robots, sensors, and other equipment to automate processes such as assembly and testing. As prices decline, applications will be found across a number of industries, including services, utilities, and construction, as well as manufacturing. Improved reliability of equipment should not constrain employment growth, however: companies increasingly will rely on repairers because any malfunction that idles commercial and industrial equipment is costly.

Employment of motor vehicle electronic equipment installers and repairers also is expected to grow as fast as the average. However, motor vehicle manufacturers will install more and better sound, security, entertainment, and navigation systems in new vehicles, limiting employment growth for aftermarket electronic equipment installers. In addition, newer electronic systems are more reliable and require less maintenance.

Employment of electric motor, power tool, and related repairers is expected to grow more slowly than average. Improvements in electrical and electronic equipment design should limit job growth by simplifying repair tasks. More parts are being designed to be easily disposable, further reducing employment growth.

Employment of electrical and electronic installers and repairers of transportation equipment is expected to grow more slowly than the average, due to declining industry employment in rail transportation, aerospace product and parts manufacturing, and ship- and boatbuilding.

Employment of electrical and electronics installers and repairers, powerhouse, substation, and relay is expected to decline slightly. Consolidation and privatization in utilities industries should improve

productivity, reducing employment. Newer equipment will be more reliable and easier to repair, further limiting employment.

Earnings

Median hourly earnings of electrical and electronics repairers, commercial and industrial equipment were \$19.77 in 2002. The middle 50 percent earned between \$15.13 and \$24.03. The lowest 10 percent earned less than \$11.71, and the highest 10 percent earned more than \$27.08. In 2002, median hourly earnings were \$23.68 in the Federal government and \$16.87 in building equipment contractors, the industries employing the largest numbers of electrical and electronics repairers, commercial and industrial equipment.

Median hourly earnings of electric motor, power tool, and related repairers were \$15.49 in 2002. The middle 50 percent earned between \$11.82 and \$19.99. The lowest 10 percent earned less than \$9.32, and the highest 10 percent earned more than \$25.34. In 2002, median hourly earnings were \$14.05 in commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance, the industry employing the largest number of electronic motor, power tool, and related repairers.

Median hourly earnings of electrical and electronics repairers, powerhouse, substation, and relay were \$24.85 in 2002. The middle 50 percent earned between \$20.81 and \$27.90. The lowest 10 percent earned less than \$15.92, and the highest 10 percent earned more than \$32.08. In 2002, median hourly earnings were \$25.69 in electric power generation, transmission, and distribution—the industry employing the largest number of electrical and electronics repairers, powerhouse, substation, and relay.

Median hourly earnings of electronics installers and repairers, motor vehicles were \$12.51 in 2002. The middle 50 percent earned between \$9.97 and \$16.02. The lowest 10 percent earned less than \$8.47, and the highest 10 percent earned more than \$19.45.

Median hourly earnings of electrical and electronics repairers, transportation equipment were \$18.56 in 2002. The middle 50 percent earned between \$13.85 and \$22.96. The lowest 10 percent earned less than \$10.68, and the highest 10 percent earned more than \$26.87.

Related Occupations

Workers in other occupations who install and repair electronic equipment include broadcast and sound technicians and radio operators; computer, automated teller, and office machine repairers; electronic home entertainment equipment installers and repairers; and radio and telecommunications equipment installers and repairers. Industrial machinery installation, repair, and maintenance workers also install, maintain, and repair industrial machinery.

Sources of Additional Information

For information on careers and certification, contact any of the following organizations:

- ▶ ACES International, 5241 Princess Anne Rd., Suite 110, Virginia Beach, VA 23462. Internet: <http://www.acesinternational.org>
- ▶ Consumer Electronics Association, 2500 Wilson Blvd, Arlington VA. 22201-3834. Internet: <http://www.ce.org>
- ▶ Electronics Technicians Association International, 5 Depot St., Greencastle, IN 46135.
- ▶ International Society of Certified Electronics Technicians, 3608 Pershing Ave., Fort Worth, TX 76107-4527. Internet: <http://www.iscet.org>